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China's Changing Role in Industrial Value Chains – and Reverberations on Industrial Actors in Germany

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Abstract

The paper addresses the position occupied by China in the new international division of labour now developing as value chains become increasingly fragmented and work is relocated in the context of globalisation. China is currently experiencing an extremely dynamic industrialisation process, and worldwide foreign direct investment in industry is concentrating strongly in the People's Republic. A comparative study of developments in the automotive and infocom industries examines a number of issues. Firstly, differences in development dynamics and corporate strategy in the two industries are examined. Secondly, the demands multinational companies make of their locations in China and their supplier structures are investigated. Thirdly, differences in the "embedding" of the new multinational company locations in China are investigated. Particularly interesting is the development of territorially integrated production clusters and the role of industrial parks. The fourth issue to be looked at is the impact of developments in China on actors and locations in Germany.

Zusammenfassung

Im Zentrum des Papers steht die Frage nach der Position Chinas in der neuen internationalen Arbeitsteilung, die sich gegenwärtig als Folge der zunehmenden Fragmentierung von Wertschöpfungsketten und der Verlagerung von Arbeit im Zuge der Globalisierung herausbildet. Dabei wird von der Beobachtung ausgegangen, dass in China gegenwärtig ein äußerst dynamischer Industrialisierungsprozess stattfindet und sich die weltweiten industriellen Direktinvestitionen in hohem Maße auf China konzentrieren. In einer vergleichenden Untersuchung von Entwicklungen in der Automobilindustrie und der InfoCom-Industrie wird den folgenden vier Fragen nachgegangen: Erstens werden Unterschiede in der Entwicklungsdynamik und in den Strategien der Unternehmen der beiden Industrien betrachtet. Zweitens wird nach den Anforderungen hinsichtlich der Kompetenzen gefragt, die von den multinationalen Unternehmen an ihre Standorte in China und ihre Zulieferstrukturen gestellt werden, untersucht. Drittens werden Unterschiede in der „Einbettung" der neuen Standorte multinationaler Konzerne in China untersucht. Von besonderem Interesse ist in diesem Zusammenhang die Entstehung territorial integrierter Produktionscluster und die Rolle von Industrieparks. Viertens geht es um die Frage, welche Konsequenzen sich aus der Entwicklung in China für Akteure und Standorte in Deutschland ergeben.

Contents

1. Introduction

One of the most marked characteristics of globalisation has been the dynamic restructuring of industrial value chains.[1] This restructuring has been both a major driver of globalisation while itself being driven by globalisation. The outsourcing of corporate functions leading to greater specialisation and fragmentation in value chains and the off-shoring of activities are the main features of this transformation. It creates risks and opportunities for corporate and political actors and its evolution is highly uncertain for all parties. A state of equilibrium in a new international division of labour is not yet apparent.

In this restructuring process, China[2] has been playing a more and more dominant role since the middle of the last decade. Explanatory factors are state policies explicitly designed to attract and regulate foreign direct investment and the dynamic growth of demand on the domestic market. But these factors do not suffice to explain the size and speed of international engagement in China. In analysing recent developments in the automotive and the infocom industries, the paper addresses four questions:

1. What factors explain the central role of China in the most recent developments in restructuring industrial value chains?
2. What characterises the “embedding” of new industrial structures and processes in China and what evidence is there for the development of capabilities?
3. What are the commonalities and differences between industries in this regard?
4. What are the consequences for industrial actors and locations in Germany?

The paper is explorative, trying to assess emerging trends. It draws on empirical research conducted by the authors on several occasions during short visits to China.[3] The focus of discussion will be the so-called foreign invested enterprises (FIEs)[4], i.e. foreign companies that have established productive businesses in China mostly in the form of joint ventures with Chinese partners. The development of purely Chinese companies is beyond the scope of this study.

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1 Cf. on the term „value chain“: Sturgeon (2001).

2 In this paper China stands for the People's Republic of China.

3 A one-week study tour by Ulrich Jürgens and H.-R. Meißner with company interviews in the supply chain of telecommunication companies in China in summer 2002 and several study trips to China by Rolf Rehbehn between 1992 and 2001 as President of Quality Management, Siemens Communication Devices.

4 Based on the "Law on Foreign-Capital Enterprises" of 1986 (Taylor et al. 2003, 63).

The paper is structured in a straightforward way. The following chapter discusses differences of industry organisation between the automotive and infocom industries and provides some evidence of differences in the speed and direction of their engagement in China. The next chapter discusses capability development at Chinese locations within the transnational production networks of multinational companies. It provides evidence of fast upgrading of competence levels. The relevance of industrial parks as an instrument for “embedding” multinational operations in the Chinese socio-political context is highlighted as a particularly important factor.

The fourth chapter deals with some consequences for home countries discussed against the background of the debate on the future of industry in Germany. The paper ends with a brief summary and conclusions.

2. Comparing Industry Dynamics in the Automotive and the InfoCom Industries

China seems to present an almost clean sheet for global corporations in deciding how to organise their global value chains. And China certainly offers considerable advantages in terms of wages and salaries. Figure 1 provides some information about labour costs which is certainly one of the general factors explaining China's advantage.

Figure 1: Salaries/Month in China, Taiwan, and Japan of Selected Occupation Groups (in US Dollars)

	India	**China**	Singapore	Taiwan	Japan	USA
CEO	1,764	**2,865**	11,131	13,638	18,300	31,200
Manufacturing Director	937	**1,866**	6,740	6,986	12,045	11,592
Factory/Plant Manager	724	**1,399**	4,639	6,036	7,992	8,052
Systems Engineer	490	**746**	2,290	2,573	4,663	5,460
Production Supervisor	384	**589**	1,847	2,253	3,485	3,917
Secretary	176	**393**	1,326	1,415	1,720	2,208
Chauffeur	147	**279**	975	1,520	1,217	2,442

Source: ASIAWEEK 2000

Labour costs, however, are not sufficient to explain the rush into China. Neither the timing nor the speed of relocation (off-shoring) can be explained by this factor alone. Both automotive and infocom activities have developed at a breathtaking speed in China over the last five to ten years. Some illustrative facts and figures may suffice to recall this well-known phenomenon:

In the auto industry, sales of passenger cars in 2003 exceeded the previous year by more than 80%. The global players in the industry have rushed into China – almost all with major investment projects to set up or expand operations there (Weider 2004; Goldman Sachs Global Equity Research 2003; Xing 2002). In 2002 car manufacturers were planning investment projects of more than 2 million cars, doubling the existing capacity for passenger cars (Xing 2002). In 23 provinces and cities new automotive factories are currently under construction (Sieren 2003). "Looking ahead", states the China Industry Devel-

opment Report[5] on the Auto Industry in China 2003, “opportunities are enormous in auto industry. In the next 10 to 15 years, China will become the largest auto market in the world (…). By then, annual auto production could reach 17 million units and registered autos 100 million units” (The Ministry of Science and Technology 2002). Obviously, there are all the indications of a bubble situation at this stage.

In view of the growth situation in China, the development of the Chinese auto industry has been geared to the domestic market. But this is about to change. At Volkswagen (VW) it is expected that, within the next three years, 10% of Chinese VW production can be exported, and that exports will play an important role in the future. More important, however, will be the export of parts. General Motors wants to buy US$ 10 billion worth of parts per year from China, and GM and Ford are pushing their suppliers to open factories in China. American manufacturers are particular keen to benefit from the low-cost conditions in China.[6] Indeed, the export of car components from China is increasing rapidly. In 2003 China exported US$ 2.4 billion in car parts, up from US$ 1.8 billion in 2002. But this is a small amount compared to the annual car parts export target of US$ 70 billion to US$ 100 billion set by the Chinese government for 2010 (Murphy 2004).

To attain this goal, the Chinese parts industry will have to improve their cost and quality levels considerably. At present they are hardly competitive on the global market. “Most of the country’s 1,500 or so car-parts makers of a decent scale have bloated pay rolls, outdated manufacturing equipment or little experience mass-producing parts with the rapid design changes that U.S. automakers routinely make,” a buyer of the Big Three is quoted in an article of Wall Street Journal Europe (Shirouzu 2003).[7] A report by the Boston Consulting Group puts the cost disadvantages resulting from these inefficiencies in the supply sectors at between 10% and 20% for large established joint ventures and up to 40% for smaller car companies in China (The Boston Consulting Group 2002).

Greater competitiveness on international markets is one of the main goals of the new Automotive Industry Development Policy formally declared by the Chinese government in 2004. The new policy reconfirms the goal that the automotive industry should become a “pillar industry” of China by 2010 and, as such, will remain under the macro-level control of the central government. The new policy encourages consolidation in the industry from currently more than 120 to only a few major corporations. The policy also states that the Chinese

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5 The China Industrial Development Reports are provided on the basis of “joint efforts by China Economic Information Network, government ministries, industrial associates and research institute specialists they are designed to serve corporate leaders in policy making” (http://ce.cei.gov.cn/e_report/index.htm).

6 (“The rush to source automotive parts from China has turned into a stampede”, writes G. Mercer from McKinsey.) “Sourcing from China, the Organisational Challenge”, in: Automotive & Assembly Newsletter, 31.7.2003

7 “It is such a concern”, the article continues, “that Ford has decided to build parts – receiving centers in the U.S. to verify the quality of goods being shipped from China and other low-cost countries.” (Shirouzu 2003)

automotive industry should develop so that it is competitive both domestically and internationally, and eliminates inefficiency and low quality (Auto Industry 2004).

The automotive industry has followed the infocom industry in its rush into China. While the latter had started its frantic development in the second half of the 1990s, the automotive industry has been accelerating only since 2002. The development of the infocom industry has thus been even more dynamic, displaying not only many similarities but also differences. China seems on its way to becoming the world's main production base for electronics parts. While electronics production in emerging markets will nearly double – from US$ 65 billion in 2001 to US$ 125 billion by 2005, China will take the lion's share of this growth, 77%. It will increase its share in global electronics production from 8% to 14% according to a study by the International Finance Corporation and Booz Allen Hamilton (2003). The study concludes: "China will continue to hold commanding positions in key value chain elements such as assembly, displays, and semiconductors, as it evolves into the hub of electronics manufacturing." Research by the Japan Electronics and Information Technology Association (JEITA, 2003) indicates that China including Hong Kong is expected to be the top producer of eight out of twelve key electronic products in 2003. China is likely to produce 41% of all DVD-Rom drives, 62% of all DVD players, 37% of desktop personal computers, 27% of colour televisions and 30% of mobile phones.

Within a few years China has become one of the major world exporters of communication equipment. In fact, China became the United States' number-one supplier of high-tech goods ahead of Japan in 2002 (http://www.pcb007.com, News of 13 August 2003). And the China Industry Development Report on the communications equipment manufacturing sector in China 2003 expected: "that communications equipment manufacturers would be going global, that imports will fall further in the next few years. Domestic manufacturer capabilities were greatly enhanced. Many high-end equipment could be made independently in mass production. Sino-foreign joint ventures, with the increasing perfection in R&D, would become production basis to meet global demand". (China Economic Information Network 2003)

3. Requirements for Capability Development and Infrastructure of Chinese Locations

3.1 Capability Development

Driven by globalisation as well as technology changes, restructuring in the infocom industry has been a particularly dynamic process. The shift of value-added from final producers to component makers has serious effects on cost and employment structures. Thus, in the case of the infocom industry, suppliers now account for 85% of production costs, and in the case of the car industry their share is around 70%. In any case, achieving cost advantages and assuring consistent, robust quality performance throughout the value chain has become a primary concern for final producers in both industries. Up to now, final producers have mostly relied on pressuring suppliers to reduce prices. In the future, more emphasis will be laid on coordinating processes and integrating suppliers more closely, and on harmonizing processes across interorganisational interfaces. The consequences are far reaching changes in company organization and management. Process organisation and the evenness of flows in the whole value chain have gained priority over improvements realisable at certain stages within the chain. At the same time, deverticalization requires all companies regardless of size and national or multinational status to find new responses in each of the four fundamental dimensions

- time: cycle time, response time, time to market;
- costs: personnel costs, production costs, administration costs;
- capital: capital turnover, capital productivity, capital allocation;
- quality: non-conformity costs, process quality, product quality, service quality.

Improvements have to be made simultaneously in all four dimensions with particular emphasis on quality, however. In any case, competition in both the automotive and infocom industries will take place between whole process chains and not between single companies focusing on their internal organisation and, in particular, on manufacturing. At the same time, the actual value chains will not evolve into solid organisational structures but remain flexible to allow shifting partial processes in response to changing company strategies.

Capabilities of Local Suppliers

In the past, the primary corporate potential for improving productivity was seen in the production area. Rationalisation thus concentrated on production. The same is true for quality. Quality has been related to production and was identified with product quality. However, seeing that around 70% of the causes for failing to meet quality requirements are not attributable to final producer in-

house production, in both the car and the infocom industries, the essential improvement potential has to be realised outside the production areas of these companies, i.e., either at the product development stage or at suppliers. Increasingly, suppliers are also attaining greater responsibility in areas such as product development, production planning and logistics. Last but not least, focal companies expect their suppliers to follow them to their foreign locations and supply operations there in the just-in-time mode and with consistent quality. As a consequence, suppliers have followed their end customers in setting up operations in China. This requires both financial power and a high degree of "system competence" on the part of suppliers.

This close integration between processes of the final producers and their suppliers increases specialisation among the latter while increasing their dependence on the former. The technology of the end product determines the level of the technological capability which has to be mastered by local suppliers.[8] In China, this capabilities requirement is supported by a Chinese government policy requesting companies investing in China to bring in their latest generation technology and requiring them to achieve a certain level of local content and exports after a given period.[9] Local content requirement, however, had to be abolished when China entered the World Trade Organisation (WTO) in late 2001.

In the infocom industry, technological developments have strongly supported the trend towards shifting value-added functions to suppliers, primarily in the compression of additional functions into integrated circuits or components. This in turn requires changes in casing technology. Both developments, especially under pressure from the dramatic speed of product innovation, has lead to the restructuring of production. One of the main consequences is greater automation. Whereas in 1980 only 40% of all components were fitted automatically worldwide, today the figure is over 90%. Consequently, manufacturers have increased the level of automation in China, too, foregoing some of the advantages of lower labour costs in direct areas. Labour cost advantages remain in the indirect areas, however. Another consequence is the opening-up of product architectures following the example of the PC industry. A result of open product architecture is the high degree of standardisation now attainable in production. This allows outsourcing and off-shoring of production to electronic manufacturing service (EMS) companies, so-called contract manufacturers. (cf. Lüthje et al. 2002; Borrus et al. 2001)

The enormous growth of a group of multinational contract manufacturers in the electronics industry since the second half of the 1990s is among the remarkable phenomena to be observed in the restructuring of value chains in the electronics industry. Figure 2 gives an impression of this dynamic. It shows the development of employment in leading international contract manufacturers.

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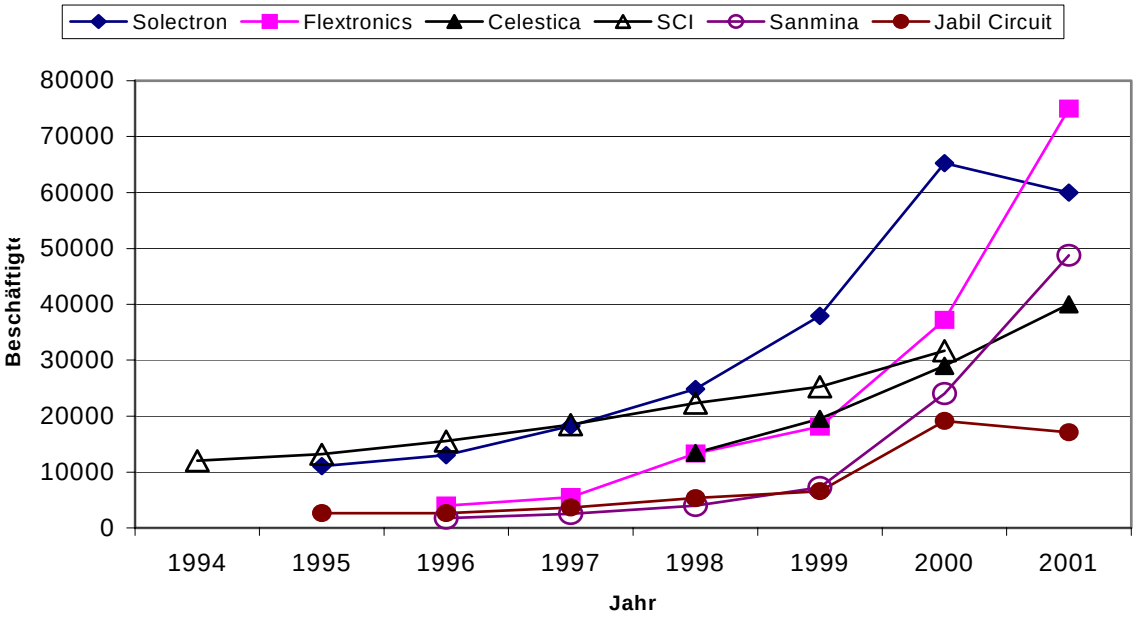
8 Cf. on related conceptual issues Ernst and Kim (2001).

9 Cf. on the automotive policy of the Chinese government: Harwit (2001).

Figure 2: Employment Developments at Selected Contract Manufacturers



Source: Jürgens et al. (2002, 216)

Contract manufacturers, including all the companies listed in figure 2, are not surprisingly among the fastest growing FIEs in China. In the automotive industry, the contract manufacturer business model still plays a marginal role.

The Outsourcing of Production in the Infocom Industry

The standardisation of product interfaces in the infocom industry has meant that manufacturing equipment is now being offered by only a handful of manufacturers worldwide, so that there are hardly any differences between manufacturers in production processes. Only in final assembly and functional testing can they distinguish themselves from competitors. This explains why capital-intensive production processes in the infocom industry – following the Wintelist model[10] – are no longer regarded as a core competence of final producers.

Whether production follows the markets, exploits local cost advantages, or is assigned to contract manufacturers is a question of corporate strategy. All three cases apply to the Chinese situation.

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10 Cf. on the model of Wintelism Borrus and Zysman (1997); Jürgens and Sablowski (2003). In the traditional industrial company the production function is regarded as a central area of competence. It is mainly in the area of production that, technically and organisationally, the advantages of "economies of scale and scope" can be mobilised. "Production" is no longer a core competence in the Wintelist model, however. Core functions here are research and development, and marketing and sales, while manufacturing is tending to be regarded as "dead weight", as a burden for the balance sheet and a risk in view of the high market fluctuations and short product cycles. The Wintelist company, ideally, is "fabless".

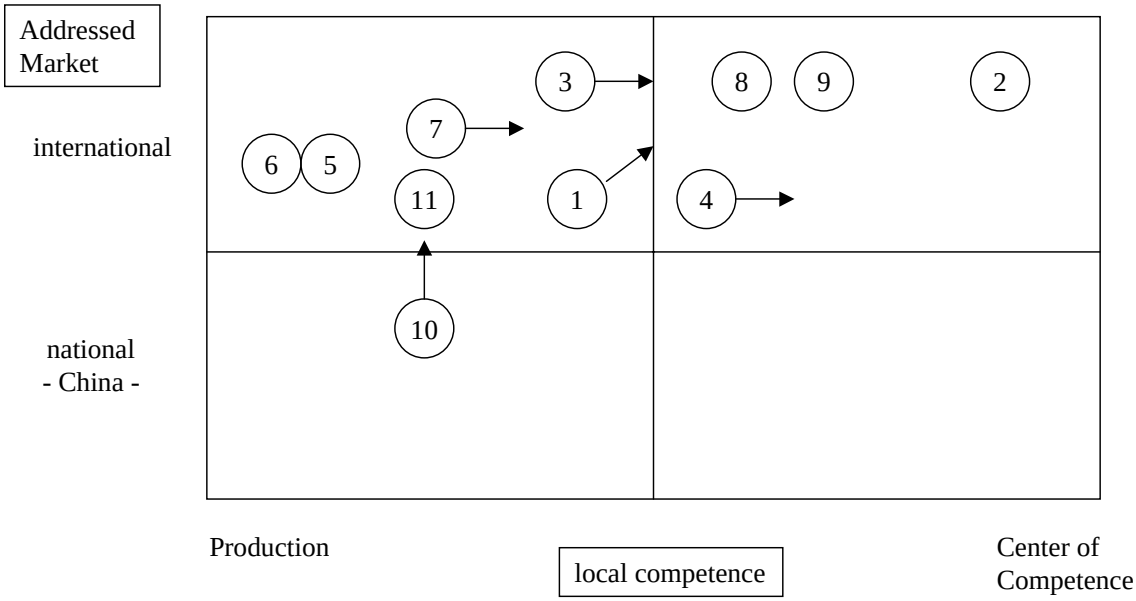
In the past, it has often been argued that product development and series production should be located at the same site for reasons of know-how transfer and product monitoring. At least for the infocom industry, this argument is no longer valid for two reasons. First, decisions on production location may have to be made flexibly and at short notice, and, second, markets require new product generations to be introduced simultaneously in different plants worldwide, so that product launches have to occur in parallel at many sites. This can be achieved only if the company has full control over the whole process from the early product development stage to final assembly. Various factors have contributed to an increase in demand for higher functionality and quality in China, necessitating a better infrastructure and greater competence at Chinese locations. They include local market demand for first-generation products; insistence by the Chinese government that companies introduce their new technologies when investing in China; and the expectation of multinational companies that their Chinese locations will reach world market standards, allowing them to export their products. Mastering this competence development defines the demands being made on the infrastructure at Chinese production locations.

In the early 1990s, the standard of production location infrastructure was low. Second or even third generation level technologies were being used in keeping with the low standards of national markets. Affiliates were closely integrated into the international corporate structure. Technological competences were concentrated at headquarters from where they were transferred to the foreign locations.

In the case of the infocom industry, this situation has meanwhile changed. While technology competence remains at headquarters, local adaptation engineering and product monitoring, including responsibility for the quality of material purchased in Asia and the quality of the end product have become a local responsibility. This upgrading of demands and capabilities is true not only for Siemens and other brand-name infocom industries but also for component suppliers. The automotive industry is lagging behind this development. Figure 3 shows the situation of local affiliates of a number of international companies operating in China with regard to market strategy, capability level, and local competence – based on our own research. It should be noted that all companies are either fully or partially owned by international companies. Purely Chinese companies currently play only a marginal role supplying low-tech parts in high-tech production chains.

Of the eleven companies, only Volkswagen with its Chinese operations produced almost exclusively for the Chinese market. However, the company has recently begun to export small numbers of cars to other East Asian markets on a trial basis. The majority of companies of the infocom sector we investigated produce for the international market. Some are in the process of systematically increasing the capability of their Chinese operations to develop them into centres of competence, a level which had already been attained by four companies at the time of our research. A centre of competence usually bears region-wide responsibilities with regard to economic results, product planning (road map) and distribution.

Figure 3: Market Strategy and Capability Levels of Selected Infocom and Automotive Companies in China (2002)



Legend:

Company	*Ownership*	*Product*
1. Meadvill	100% Meadvill USA	Info Com PCB
2. Siemens Network Solution	German-Chinese JV	Info Com
3. Siemens Mobile	German-Chinese JV	Info Com
4. AMD	100% AMD USA	Info Com Components
5. Lite on Electronic	100 % Lite on Taiwan	Info Com Components
6. TMCOM Panasonic	Japanese-Chinese JV	Info Com Components
7. Fujitsu Media Device	100% Fujitsu Japan	Info Com Components
8. Solectron	100% Solectron USA	Info Com Contr. Manuf.
9. ACP Electronic	Taiwanese -Chinese JV	Info Com PCB
10. VW	German-Chinese JV	Automotive
11. GM	German-Chinese JV	Automotive

Source: Based on research of Rolf Rehbehn and Frieder Naschold in 1999 and Ulrich Jürgens and Heinz-Rudolf Meißner in 2002

All companies listed in Figure 3 showed above-average performance in process control, meaning a high and consistent production yield throughout 21 shifts per week. Combined with low wage levels in both direct and indirect areas this affords considerable cost advantages. They are only slightly offset by lower productivity levels.

While infocom products have been designed for world markets since the end of the 1990s – and this is true for both final products and components – automotive products are still focusing on regional markets. In product and process technology, multinational auto companies still tend not to transfer their latest technology to China. At Volkswagen, for instance, when the new Golf V was

being introduced in Germany in 2003, the Changchun plant started production of its forerunner, the Golf IV in the same year. But this policy seems to be changing. The Touran, the van model built on the Golf platform, was introduced in Germany as recently as March 2003, and production at the Shanghai site started in 2004. At the same time the production of the old Brazilian designed Santana has been moved from its Shanghai site to a Chinese contract manufacturer.

In general, as in the case of Volkswagen, multinational car companies have not pursued a policy of developing their Chinese locations into export bases within their global production network or into competence centres for specific company functions. For these companies, the Chinese operations serve the national Chinese market only or, in some cases, they are seen as part of a regional strategy to serve markets in East Asia. There is one notably exception, a new Honda factory in Guangzhou which will start operations in 2005. This plant is to produce cars only for export, specifically targeting the European market. Honda's Guangzhou plant will have to demonstrate the ability of China-based car manufacturing "to climb the value chain" (Murphy 2004). As an exclusively export-oriented company, Honda Guanzhou is not subject to the 50:50 rule for joint ventures and is the only FIE among carmakers to retain full managerial responsibility for its operations.

The situation is different in the infocom industry. There have been significant changes since the beginning of 2000. First generation high-technology products need special local support in this sector. Local product development teams have accordingly been set up, not primarily composed of expatriates but explicitly aiming to recruit local personnel, if possible trained in Western countries or with international experience. These changes in local infrastructure are supported by low wage costs in both direct and indirect areas. It goes without saying that engineering for local adaptations is now being carried out locally. But main product development activities are still restricted to home country headquarters.

Siemens Shanghai Mobile is a good example. The Chinese affiliate produced 14 million mobile phones in the fiscal year 2001/2002, accounting for 40% of total Siemens AG mobile production. 8 million were exported mainly to Asian countries. Due to increased pressure on costs and profit margins, this activity has been outsourced step by step. The company is now focusing more and more on R&D and the production of networks for third generation mobile communication. As a consequence, the Chinese business unit is evolving into a centre of competence responsible for product development, production marketing and financial results. General Electric and Sharp were both planning to expand their production operations and establish centres for research and development in 2002, thus developing in the same direction as Siemens.

This development is typical for the orientation of large multinational infocom companies in China, and, as we have seen, is reflected in foreign trade statistics for high-tech products. Five trends are apparent:

A first trend is the establishment of competence centres in China by an increasing number of multinational infocom companies. American companies, General Electric and Motorola, the German Siemens group and the South Korean company Samsung Electronics are among the pioneers in China in this regard.[11]

A second trend is in the focus of investment. Whereas investment used to go mainly into manufacturing, the service sector is now gaining in importance. This is true for maintenance functions, repair services, and for marketing and finance.

A third new trend concerns the "system orientation" of projects pursued by multinational companies with their investment in China. Companies are now planning their projects with a view to integration into their global business strategies from the outset.

A fourth new trend is in corporate governance. Whereas most past investment was in the former joint ventures with equal shares of foreign and Chinese partners, foreign companies are increasingly able to obtain licences as majority shareholders or as 100% foreign-owned affiliates.

A fifth trend is the establishment of regional headquarters by global players in China. At present, more than 20 global players have set up local headquarters. In Shanghai, more than 70 global players have established regional headquarters, including leading multinationals like Alcatel, General Electric, Microsoft, and Siemens.

To a large extent, developments in the automotive industry are displaying the same trends. A marked difference, however, lies in the degree to which Chinese operations are integrated into the global business strategies of the multinational companies. Chinese affiliates are restricted to national or regional strategy. Another difference is due to regulation. For the automobile companies (OEMs) the 50:50 rule still holds also under the new automotive policy issued in 2004. However, this rule has been rescinded for automotive suppliers, including car engine production. On the whole, government regulation seems to play a stronger role in the automotive industry (cf. Harwit 1995). Of particular importance in the context of our discussion are regulations on technology transfer and research and development (R&D). Thus, the new automotive policy directive not only sets a minimum investment level for new passenger vehicles enterprises of Rmb 2 billion but requires that a R&D facility be established with an minimum investment of Rmb 800 million.[12] There is no local content regulation any longer, which would no longer have been possible after China's accession to the World Trade Organisation (WTO) – but new investment projects are required to include engine production, which would ensure a minimum of 40% local production anyway. In contrast to the original draft, the new policy does not oblige foreign investors to transfer technology to Chinese local manufactur-

11 Thus, Siemens intends to increase its turnover in China to € 11 billion, this is more than 10% of the total turnover of the group.

12 Exchange rate of August 2003: 1 China Yuan Renminbi = € 0.110908.

ers. The aim is rather to foster local technology development through the growth of domestic research and development centres.

In brief, China has successfully established itself in recent years as a leading centre of production worldwide in many areas of the infocom industry, and in a number of cases is developing further to the level of competence centres. We now go on to look at one of the factors supporting this development which we regard as highly important in explaining the astonishingly smooth insertion of multinational activities into a foreign culture and a socialist political-economic context.

3.2 The Relevance of Industrial Parks

A major factor explaining the extent and speed of China's recent industrial development is the industrial park concept. The development began with the opening of special economic zones in the coastal regions of China in the 1980s (Debresson et al. 2002; Chang 1998). Since the early 1990s, the industrial-park concept has been an explicit vehicle for modernising the Chinese economy. By early 2000, industrial parks had proved to be highly efficient in attracting foreign companies, allowing them to set up their operations at breathtaking speed. Building on the experience with industrial parks gathered in the Small Tiger Economies during the 1990s, the concept has become an element in a state-led modernisation policy of a socialist country. Industrial parks appear to have offered multinational companies such ideal conditions that they have attracted these companies in great numbers.

There is only scant information about the recent industrial park movement in China.[13] The following information is therefore largely based on Internet sources.

After China set up first four and then five special economic zones in the 1980s, all kinds of development zones followed in their wake.[14] Only a limited number of all these parks have attracted foreign direct investment (FDI). A

13 Cf. Xiaojuan (2003); cf. the business guide published by China Knowledge Press (2002).

14 The establishment of industrial parks was restricted to certain areas. In 1984 13 "coastal open cities" were designated to create “Economic and Technological Development Zones” (ETDZs). 14 ETDZs were approved, followed by a further 18 in the early 1990s. China now has a total of 54 state-led ETDZs. Including local zones, more than 4,000 assorted ETDZs exist (China-Britain Business Council 2003). The industrial-park concepts in a wider definition includes the "High and New Technology Development Zones" initiated by a high-tech park programme of the Ministry of Science and Technology (MOST). By the end of 2001 there were 53 HTPs. It also includes the free trade zones (FTZs) which began in Shanghai at the beginning of the 1990s. There are now 15 such zones. More recently, export processing zones (EPZs) have been created, of which there are now 17. In addition there are border trade co-operation zones, software-development parks and university-science parks.

business guide published by China Knowledge Press (2002) lists around 270 parks in the whole of China.[15] A list provided by the law consultant firm Lehmann, Lee & Xu (2002) contains names and short descriptions of altogether 174 industrial parks.

The establishment of Science and Technology Industrial Parks (STIPs) was decided by the Chinese government at the beginning of the 1990s to speed up development of high-tech industries. In August 1988, China's National High and New Technology Industrial Development Plan, the TORCH Programme, was put into effect. Since 1991, 53 science and technology industrial parks have been approved as National STIPs by the State Council.

According to this programme, the STIPs should function as:

> "(1) a base to nurture and develop high and new technology industry;
>
> (2) a demonstration center for speeding up transfer of R&D achievements to production and technological innovation to enterprise;
>
> (3) an experimental zone for institutional reform and innovation;
>
> (4) a center displaying how S & T is relied on to boost trade and China opening to the outside world;
>
> (5) a school for cultivating high-tech enterprises and entrepreneurs;
>
> (6) a source of radiation to apply high and new technology to updating traditional industry;
>
> (7) a new community that embodies modern civilisation of socialism."
>
> (China Internet Information Center 2002a)

In 1997 ten STIPs in China have opened up to APEC members. In 2000 the Ministry of Science and Technology (MOST) and the Ministry of Foreign Trade and Economic Cooperation (MOFTEC) jointly identified 20 STIPs as "National High-tech Export Bases".

By 2000 there were altogether 20,796 enterprises in the STIPs. They employed 2.51 million workers, including 560,000 scientists and engineers. By 2005, according to this report, total revenue from technology transfer, industrial product and trade will be doubled to Rmb 1,700 billion (€ 189 billion)[16], and total value of industrial production Rmb 1,400 billion. By 2010 the report expects that total STIPs revenue will constitute 20% of the total industrial increase in national GDP and 20% of national exports (China Internet Information Center 2002a).

A report by "National Science & Technology Industrial Parks of China" (2000) summarises the development of the STIPs in the first decade: "After 10 years of construction and development, the new and high-tech zones have made gigantic progress in reform and development, in construction of an innovative system and of the enterprise incubation capacity, in fostering innovative

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15 Industrial parks play an important role also in other South East Asian economies. According to a compilation of worldwide industrial parks by GlobalManufacturer.net Taiwan alone has more than 80 individual industrial districts, science parks and export processing areas with more than 20 under construction and even more in the planning stage.

16 Exchange rate August 2003: 1 China Yuan Renminbi = € 0.110908 .

personnel and in making important contributions to obtaining the second-stage strategic objective of China's socialist modernisation drive." The New and High-tech Zones "have promoted the reforms of property rights, distribution, labor, personnel and social security systems and the establishment of a modern enterprise system." (China Internet Information Center 2002b)

Obviously, the STIPs have played a central role in developing a high-tech industry in China. For an example of the enormous dynamic and potential of this development we will take a brief look at the – admittedly outstanding – example of the Suzhou Industrial Park.

The Suzhou Industrial Park was founded in 1994 as a joint venture between the Chinese and Singapore governments, adopting Singapore's experience in economic development and public administration. SIP has a total area of 70 square kilometres; in the first phase an area of 12 square kilometres was developed. When fully developed, it will accommodate a population of 600,000 and provide 360,000 jobs.

The Suzhou Industrial Park had attracted over 764 foreign enterprises by mid-2002, a cumulative total contractual investment of US$ 13.4 billion and utilized contractual investment of US$ 4.9 billion (the aim is to secure US$ 10 billion in actual foreign investment within the next three years). Located in the park are 81 companies from the global fortune 500 and 63% of the projects recorded more than US$ 100 million in investment. Of all projects accumulated up to November 2001, 45% were financed by European and American investors, 26% by Singapore investors, and 12% by Japanese and South Korean investors. The IT sector alone absorbed 43% of foreign investment projects.

The Suzhou Industrial Park is run by a joint venture company (originally 50:50, since 2000 65% held by Chinese and 35% by a Singapore-led consortium). The park administration provides services in every stage as a "one-stop shop" (plant construction, labour recruitment, business administration). Companies only rent the premises for their operations and can focus investment on equipment and machinery. The park has established a computer-based customs declaration and taxation system, a human resources centre, real estate consultant market, and a number of finance and public accounting firms. An export processing zone (EPZ) enables companies to bypass many customs restrictions.

Industrial parks for foreign companies setting up operations in China offer a number of valuable services and functions:

(1) Administrative support: the administrative organs of the new and high-tech zones on the basis of the TORCH Programme are granted "provincial-level management powers" regarding planning, construction, land use, finance, industrial and commercial administration, taxation, examination and approval of projects, labour and personnel, and imports and exports." (China Internet Information Center 2002b). Rather than establishing a bureaucratic structure, emphasis is laid on streamlining administrative structures, strengthening service and simplifying formalities ("small organs and extensive service").

(2) Tax reductions and preferential arrangements: the TORCH Programme specified preferential conditions such as reduced income tax, provision of special financing sources etc. The individual parks are increasingly competing to offer special conditions in order to attract investors. The following list provides an example of the preferential policies of the Automobile Parts and Components Production Park located in the Dalian Development Area:

a. Land Price: most favourable price will be given to the projects in the Park
b. Income Tax: 15% income tax rate is adopted, in addition, two years exemption (start from making profit) and subsequent three years reduction (rate of 7.5%) will be given.
c. Local Income Tax: 3% income tax rate is adopted, and seven years exemption will be given.
d. VAT (value-added tax): rate of 17%.
e. Land Appreciation Tax and Factory Building Purchase Deed Tax: free.
f. Profit Remittance Tax: free.
g. Individual Income Tax: rate of 5-45%, after Rmb 1,200 deductions for Chinese employees and Rmb 4,000 for foreign expatriates.
h. Workers Recruit Policy: the urgently needed technical and managerial staff and their families could be recruited from outside of Dalian without paying for Residents Multiply Fee.
i. Production Equipment Depreciation: enterprises in the Park could have the shortest production equipment depreciation period in accordance with State regulations.
j. Other Policy: enterprises in the Park could have related financial support guaranteed by SMEs (Small and Medium Enterprises) Bank.

Source: http://www.dalian.gov.cn/i18n/en/investment/2203_10216.jsp – downld. September 4, 2003

(3) Human resource management support: human resource management seems an easy task for companies in the industrial park context. All of the managers we interviewed at seven manufacturers located in four different industrial parks in June 2002 underlined that a number of human resource functions were taken care of by the industrial park very efficiently. Thus, despite the speed of the build up of employment, recruitment went smoothly. And in some cases there were large numbers of recruits to be handled. One of the companies at the Suzhou Industrial Park had started operations in 1997; at the time of our visit the company employed 3,500 and the plan for the following year was to increase the workforce by another 1,400. This enormous intake of new personnel took place while many companies in the park were looking for personnel also. The short time span over which the parks were set up meant that, in many cases, up to a hundred thousand new employees had to be brought in within

only a few years. All companies emphasized the quality of university and technical schools education at establishments many of which had been founded only when the industrial parks themselves were set up. Some companies have contracts with certain technical schools, often recruiting whole school classes after graduation.

The hiring routine at company APC in Suzhou's municipal industrial park further demonstrates the ease of dealing with labour: "The local government has a human resource data base. Their human resource department picks up people from there. A human market exists – an open space where companies have a booth with a banner. At a certain date of the month job seekers come and in some cases job interviews are carried out right on the spot. Common factor for companies is to go to a school and interview students in this school. Our company has a contract with certain schools to hire each year a certain number. Here in China you hire a lot and also fire a lot." (Interview June 19, 2002)

As this quote indicates, there is no problem in hiring and firing individual workers. However, there is no experience as yet with how larger-scale redundancies can be handled.

In view of rapid population growth, many workers live in dormitories established in the industrial park. In the case of the Kunshan industrial park, home of another company we visited, the population of the local town of Kunshu has increased within a couple of years from 600,000 to 800,000; 200,000 come from outside the area and most live in dormitories.

(3) Industrial relations: last but not least, the local government and industrial park administration serve as a buffer in all questions of industrial relations. Again, all companies visited mentioned their satisfaction in this regard. There is no union representation in the plant. Labour union representatives are present in the local or provincial government and, as we have seen, for instance, park administrative organs control recruiting policy, and deal with employee complaints. But grievances were apparently seldom articulated; at any rate, this was not a concern mentioned by the companies we visited. There is no interference by labour unions in operations management. The labour union also seemed not to exert influence in the area of wages. Low labour costs have, after all, been one of the motives for coming to China mentioned by most companies visited. This was even true for Taiwanese companies. Wages at one of the Taiwanese companies we visited were between 15% and 20% those paid on Taiwan. In any case, the union has not sought to obtain special wage increases from foreign companies. For instance, one of the American-owned electronic manufacturing service (EMS) firms we visited, set the base salary at 60% to 70% of the local market level. A bonus programme allowed only better performing employees to add a further 20% to 30%.

In sum, it can be said that the industrial park movement has played an enormously important role in China's development into the world's leading electronics functional location. Industrial parks have played a key role in capability de-

velopment through close horizontal and vertical communication and cooperation within the industrial park. This development also demonstrates the great importance of capability development and competences of municipal and regional governments to manage the industrial parks and deal with multinational companies.

3.3 Differences in Location Structures between the Two Industries

The industry-park movement of the 1990s specifically aimed at attracting information technology (IT) companies and did so with great success. By 2002 about 50% to 80% of IT products were being produced by enterprises based in the New and High-tech Zones. Xiaojuan stresses the importance of the emergence of FIE's industrial clusters as "a salient feature in China's effort to attract foreign direct investment" (Xiaojuan 2003, 23). "Judging from the trend", Xiaojuan continues, "FIEs industrial clusters are emerging in more cities and regions in China. If this trend is allowed to continue, some Chinese cities are likely to become global manufacturing centers for some of the major industries." (ibid)

A characteristic feature of the industrial clustering phenomenon in China is that certain cities have become leading centres for specific industries. Thus Dongguan, a small city in the Guangdong province, one of the earliest industrial clusters on the Chinese mainland, has become the leading desktop computer and computer parts manufacturing centre. The industrial chain in Dongguan is so complete that the city is able to supply 95% of all component parts needed to assemble a computer.[17]

While the Dongguan cluster has focused on midlevel technologies, the Suzhou cluster has become the centre of laptop computer manufacturers requiring high-tech capabilities and a better educated workforce. The higher technological level implies higher requirements for supplementary industries. Taiwanese investors have played by a central role for both the Dongguan and Suzhou industrial clusters.

Due to special preferential policies to facilitate the growth of integrated circuit production, many local governments have assigned priority to integrated circuit production. The most massive FIE cluster in the integrated circuit industry has developed in Shanghai. Again, Taiwanese enterprises have taken the lion's share of this industrial cluster.

Typically, these clusters encompass leading multinational companies in each of these industries, component manufacturers, often from Taiwan, and a range of contract manufacturers (EMS firms) offering general and specific

17 “Of the importance of Dongguan’s IT manufacturing industry, an IBM vice president remarked to the effect that a mere 15-minute traffic jam on the Dongguan-Shenzhen express way is enough to cause worldwide fluctuations in computer prices!” (Xiaojuan 2003, 17).

manufacturing functions. In many cases these component suppliers and EMS firms have been persuaded by the lead firms to set up their operations in the surroundings. For example, in the case of the FIE cluster in Shanghai, Motorola and Sony have both asked Taiwanese EMS to set up factories near their operations.

A new type of industrial park is the Xingwang Industrial Garden established in Beijing in 2001. This "industrial garden" was set up mainly to serve Beijing Capitel Nokia Mobile Telecommunications, a joint venture between Nokia and its Chinese partner, the Capitel Group (to be referred to as Beijing Nokia). Beijing Nokia produces and sells cellulous system equipment and digital mobile telephones in China. Nokia is one of the largest FIEs in China, and the company is a major exporter selling over 50% of its products to European and Asian countries.

The Xingwang Park is China's first industrial cluster for mobile telecommunication equipment encompassing the complete industrial chain. The Xingwang Park also is the first industrial park centring on one multinational lead company. Nokia, however, stresses that it does not object to companies operating in the park supplying its competitors with components, and invites other telecommunication companies to set up in the park. The aim of the park is to engage in research and development, manufacturing, marketing, and services for mobile telecommunications products. By mid-2002, the park had already attracted fifteen renowned enterprises, including Sanyo lithium batteries, radio-frequency chips from Taiwan, precision integrated circuit boards, and Foxconn's production and processing services as EMS. In the final stage more than 30 enterprises will be clustered in the park, creating more than 15,000 jobs. (Nokia.com, 2001)

The Xingwang (Nokia) Park is an important element in the strategy of the mother company to remain a manufacturer of mobile phones. The decision to set up the park was made against the backdrop of a global slump in demand for mobile phones and telecommunication equipment in general. All multinational companies had to cut back their workforces and lower their sales forecasts in this period. While Ericsson transferred its production of phones to a Singaporean company, and Motorola expanded its outsourcing also to save costs, Nokia insisted on producing its handsets independently. By setting up its production operations in closest proximity to the supplementary companies in the industrial park and concentrating its worldwide production operations there, Nokia expects to realize the greatest manufacturing efficiencies.[18]

Nokia has very consistently pursued the just-in-time industrial-park idea. Siemens is too small to follow this model. The Siemens Industrial Park located in the Pudong development area of Shanghai accommodates only few of its

18 “It is Nokia’s hope that this mode of production will revolutionize and optimize the allocation of personnel, information, and circulation, raise efficiency and development, production, management and the utilisation of resources, and achieve the goal of zero inventory through a sizable economic scale, thereby enhancing Nokia's competitiveness in both Chinese and global markets.” (Xiaojuan 2003, 22)

suppliers. Other Siemens suppliers are located in Suzhou, or in Shenzhen province. Motorola has tried to pursue the industrial-park idea, but a lack of business success induced the company to change its strategy and contract out a considerable share of its products to original design manufacturers (ODMs), i.e. contract manufacturers which design and produce complete products sold under Motorola's name.

As we have seen, the industrial park movement of the 1990s was aimed specifically at the information technology (IT) industry. Automotive activities have so far been marginal in these parks. Lehmann, Lee & Xu names 60 parks with activities in electronics, IT and related industries, but only 9 parks with automotive activities (http://www.lalawfirm.com.cn/links/hightech.htm).

While in China an infocom company has thus assumed the leading role in setting up a modern industrial park operating on just-in-time principles, outside China this form of industrial organisation has so far primarily been the domain of the automotive industry. On the basis of experimental European and American projects in Latin America, industrial parks in this sector have been established primarily in Western Europe around carmaker assembly plants. Similarly, clusters of R&D firms have formed around the development centres of auto manufacturers. (Jürgens 2003)

Since the 1980s, after the central government had declared the automotive sector to be a key industry, a decentralized structure has developed in China owing to the ambition of individual provincial governments to form complete value chains in their provinces around the respective provincial champions. The resulting structures resembled the Japanese keiretsu. The establishment of joint ventures with Western carmakers induced the strategic suppliers of these firms to set up as FIEs in China, with the support and on the insistence of the automotive firms. Since the joint venture principle initially applied, firms set up largely in existing regional structures. The creation of modern industrial parks in the vicinity of auto firm assembly plants is a very recent phenomenon.

An important difference between the infocom and automotive industries is the size of components and modules to be supplied and the complexity of final assembly processes. The need for just-in-time delivery and the resulting reduction in transport costs are less urgent requirements in the infocom industry. This means that industrial parks can cluster suppliers (and contract manufacturers) of different final producers. Carmakers, in contrast, seek to form supplier clusters that are as model-specific as possible and in the immediate vicinity of their own assembly locations.

Another difference is that FIEs in the infocom sector have to rely on the group of internationally leading suppliers – especially from Taiwan and Japan – except for a very small percentage of simple components that can be provided by local Chinese firms. And it is these leading international firms that locate as FIEs in the industrial parks. Carmaker industrial parks designed on just-in-time principles, in contrast, bring together only a small group of strategic (module) suppliers, so-called first tier suppliers. Second, third, and fourth tier suppliers provide the first tier with the components they require.

Such a structure has not yet developed in China. But many first tier suppliers of multinational auto firms have meanwhile also set up as FIEs in China. These FIEs, as well as a small number of local Chinese producers, attain world class standards in terms of quality, as a benchmarking study on selected components has shown. (Sutton 2004). The quality problem mentioned at the beginning is, as this study shows, primarily a problem of local second tier and lower level suppliers.[19]

In China, the establishment of international industrial parks to attract multinational automotive suppliers and develop integrated production complexes has not been promoted by central government but by provincial and municipal governments, and only very recently. Particularly worth noting are the industrial park projects in Guangzhou, geared particularly to Japanese carmakers, and in Shanghai, where VW and General Motors have located. The Shanghai International Automobile City project, launched in 2001, and which is to be completed by 2010, is an especially interesting example.

The project was founded by agreement between the city government and 14 multinational and national Chinese carmakers. A total investment of US$ 6 billion is planned by 2010 to develop the infrastructure. The project includes not only manufacturing but also research and development facilities, a commercial centre, housing and even a new golf course. The aim of the Shanghai International Auto City is to become "an integrated auto industry base in China and Asia and an important platform for the cooperation and common development of world auto industry" (http://www.rshautocity.com/carcity/english/siacplanning_introduce.htm – downld. August 24, 2004).

The vehicles and parts production zone is divided into two parks, Shanghai Volkswagen and SIAC Spare Parts Assembly Industrial Zone. According to the real estate developer more than 100 enterprises from all over the world will set up plants here. An educational park within the automobile system is planned to supply qualified personnel for SIAC. Tongji University, one of the prestigious universities in China, is setting up an automotive school here, and upon completion students will number some 15,000. (Ibidem)

In brief, two differences are apparent between the automotive and infocom industries. First, development in carmaking lagged a decade behind, but can now draw on the experience and capabilities of regional policy makers; second, automotive industrial parks are more strongly shaped by regional development goals and adapted to regional OEM locations.

19 The investigation on which this study is based addressed supplier structures for multinational carmakers in China and India. The findings were similar for both countries: "Manufacturing best practice has spread remarkably quickly to fist-tier suppliers in both India and China over the past decade … These practices have not as yet permeated through the lower tiers of the supply chain" (ibidem, 24).

Figure 4: Layout of the Shanghai International Automobile City

Source: http://www.shautocity.com/carcity/english/siacplanning_04.htm – downld. August 24, 2004

4. Reverberations on Industrial Actors in Germany

As we have seen in this paper, the two industries seem to assign different roles to China in their global strategies. The automotive industry has been setting up its Chinese operations mainly to serve the Chinese market, and, in some cases, to become the hub for their regional strategy for East Asia. Due to the need to serve the automakers in China first or due to a lack of competitiveness in costs and quality at the current stage, automotive suppliers in China are also still focused on the national market. As we have seen, however, there are high expectations of steeply rising export rates in the medium term. The exceptional case of Honda setting up an export-oriented factory aimed specifically at the European market can be seen as a sign that the regional strategy adopted by carmakers might be for a transitional period only.

The infocom industry has assigned China a central role in its global production strategy. In this sector, Chinese locations are part of the transnational value chains of end producers and manufacturers for world markets. Processes in multinational companies' home countries thus tend to compete directly with (potential) Chinese processes. In the enlarged EU, competition is also developing with Eastern European locations, and a qualitative difference in corporate strategy is still apparent. In contrast to multinational strategies for China, there is no clear trend towards developing competence centres in Eastern European locations. Outsourcing or offshoring activities seem rather designed to realise labour cost advantages while benefiting from a good level of education within the EU internal market.

The relocation of employment from the company's home country to China and other places meant, for example in the case of Siemens, that every sixth European job in 1999/2000 was in R&D, every third in sales and marketing, and only a third (37%) still in production. In 1970 63% of Siemens' employees were still working in production. Today production accounts for only 31% of the workforce, half of whom are qualified skilled workers. In comparison Siemens' blue-colour workforce makes up 59% in North America, 66% in Latin America, and 59% in the Asia-Pacific region (Source: own interview, Siemens AG, 2002).

Both strategies have a direct impact on working time and pay models at German locations. One example is the dispute at the Siemens AG plants in Kamp-Lintfort and Bocholt, where mobile telephones and digital cordless telephones are made. Both products are under strong competition, also conducted through market pricing. A comparison of labour costs at these locations with those at a potential Hungarian site for outsourced production reveals a labour cost disadvantage of more than 30%. Faced with the alternative of accepting an adjustment to safeguard their jobs in Kamp-Lintfort – some 2500 employees were affected – a works agreement was reached to reintroduce the 40-hour week without pay compensation and waive the holiday allowance and Christ-

mas bonus. This reduced labour costs by about 30%. In return the company gave a two-year job guarantee. This internal company conflict was following with great attention by the media because it was in the nature of a pilot dispute.

This deal is likely to be emulated by other companies such as Daimler-Chrysler and VW, imposing wage settlements lower than industry-wide pay agreements at the plant level that take account of the competitive situation of the location – settlements which a few years ago would not have been accepted by labour and management.

A statement by the CEO of Siemens AG is to be seen in this context:

"Global competitiveness is one of the focal interests of the company management. Companies must constantly check whether their worldwide value chain it still right. This is just as true for development activities as for production sites and internal services. The times when it was a matter of building up and operating a complete value chain in practically every country are long since over. Today large-scale, cross-border solutions are wanted, best of all even global networks. This means that locations outside Germany are becoming more important. This in view of the fact that Siemens A.G. earns about 80% of its turnover with customers outside Germany while some 40% of value added is still generated in Germany. Regional value-added structure will certainly continue to adapt to regional business structure. To safeguard jobs in Germany, better underlying conditions are needed, i.e., lower labour costs and growth." (Pierer in the Employees Journal "Siemens Welt", No. 4, 2004)

The result is pressure on labour costs in Germany. In this respect China looks like the ultimate low-wage location. The debate on locating in China has so far concentrated far too much on this angle however. It is only now that tapping markets and the quality aspect are become more important arguments.

The fact is that technological requirements have led to a very high degree of automation in electronics manufacturing in China, too. (cf. argumentation earlier in the paper).

What is more, developments in the capability standards affecting quality have been neglected. This aspect has been stressed in a study by Roland Berger Strategy Consultants that looked at the factors and motives driving the latest wave of foreign off-shoring by Germany industrial enterprises.[20] Companies mentioned not only the expected advantages in wages and salaries but especially the high manufacturing quality to be achieved in East Asian locations. 83% of the companies questioned saw no change in conformance quality in comparison with German locations, 17% judged conformance quality to be between -1% and -10% below German standards, no one judged quality to be below -10%. The most important causes stated were excellent training of production personnel, high resource input for quality control, reworking directly during

20 The study was conducted in the first quarter of 2004. The sample of 70 companies included the sectors general mechanical engineering, plant engineering and special mechanical engineering, automotive components suppliers, and electronics, as well as microelectronics.

production. Conformance quality at Chinese locations is therefore considered higher than in Eastern Europe. 60% of companies observed no difference in Eastern Europe, 30% detected a drop of between -1% and -10% from German quality standards, and in 10% of cases the difference was more than 10% (Berger 2004: 30, 32).

These are our findings with regard to the infocom industry in China, too. A comparison of production quality and field call rates for a standard electromechanical component used in mobile telephones offers a concrete example.

One of the current world market leaders produces the identical product in large numbers at a location in Western Europe and at a location in China. The product was launched in lead production in Europe. With the expansion of the Chinese mobile telephony market and customer demand for national supply, a major proportion of capacity was transferred to a new Beijing location in 2003. At this site the component is produced for the Chinese and world markets in almost identical, highly automated processes.

Figure 5: Performance Differences between a Chinese and a Western European Production Line for InfoCom Products

	Jan.	Feb.	Mar.	April	May	June	July	Aug.
*Fall-off rate (FOR)**								
Chinese production line	0.28	0.29	0.38	0.37	0.29	0.27	0.29	0.32
West European prod. line	0.75	0.95	0.86	0.93	1.22	1.11	0.81	0.78
*Overall efficiency (OEE)***								
Chinese production line	71	71	72.2	75	79	78	76	76
West European prod. line	80	81	84	80	83	82	84	85
*Field call rate (FCR)****								
Chinese production line	20	5	1	48	249	32	87	99
West European prod. line	310	226	118	109	114	344	77	–

* FOR: fall-off rate. In this case faults in final stage of process
** OEE: overall efficiency. Actual rate of utilisation of a line measured against an estimated service life.
*** FCR: field call rate. In this instance 0 hrs. loss of customer output measured in parts per million – ppm.

Source: Own research

A comparison of strategies pursued in production locations provides a first explanation of this difference. To compensate for competitive disadvantages, German production locations have in recent years conducted sometimes rigorous cost cutting programmes focussing, as usual, on indirect activities. Process-supporting functions have also been affected. A lack of robustness in product and process design has been compensated with specialized personnel, for example from development. In the face of uneconomic process ratios, accompanying action is taken to compensate resource deficiencies, albeit it with a time

lag. For instance, programmes such as the six sigma method (Rehbehn 2003) for developing robust products and processes are now being more frequently deployed, which permit operative personnel to manage the process alone while improving production yield. It is also coming to be recognised that greater account must be taken of transfers in the development of products and processes, i.e., not material and machines are to be transferred but demonstrably robust products and processes.

Owing to low labour costs, process-supporting activities that compensate weaknesses in the manufacturing process are not an issue at Chinese locations. Indirect activities like incoming-lot and process control often require considerable labour input. Operative quality assurance is part of the organisation and supports yield and product quality. It is only a question of time before these indirect activities constitute a significant pool of costs and are consequently subjected to scrutiny. By this time, however, the demand for robustly developed and subsequently transferred products and processes will have been met, permitting rationalization in Chinese production, as well.

The two industries under study differ in one important point.

Unlike in the motor vehicle industry and mechanical engineering, production in the electrical goods industry does not have core competence status. The high degree of standardisation in production processes we have described makes outsourcing an easy step to take. Firms like Ericsson, Siemens Mobil Networks, or Nokia have transferred parts or all of their production to contract manufacturers. One consequence has been the rapid expansion of production locations together with just as rapid an increase in turnover for contract manufacturers. At the same time the multinational infocom companies spend little on modernising production at home. This tendency can also be observed in other industrial sectors as Lay and Schirrmeister have shown. (Lay and Schirrmeister 2003) Reorganising production can often be a more profitable path to take before outsourcing at the current and not the attainable state of the art.

While companies place great value on the development of new products, they pay far less attention to planning production. According to a study by the Fraunhofer-Institut für Systemtechnik und Innovationsforschung (ISI), personnel resources for planning production modernisation represent on average no more than 0.4% of the workforce. This is only one tenth of the staff employed in product-related research and development. Mechanical engineering is bottom of the league with only 0.3% (Lay and Schirrmeister 2003).

Modernisation of production is often undertaken only under constraint, for example when new products require process innovation. A lack of resources makes strategic planning almost impossible. Even firms that have put new products on the market in the past two years have not invested significantly more in modernising their production. Moreover, staff costs for process innovation do not increase with a growing proportion of employees in research and development. This contradicts the widespread thesis that product and process innovation are necessarily closely linked.

In the majority of cases, the head of production or the plant manager take on the planning work for modernising production. But they are often overburdened by day-to-day business. The sparse resources for planning modernisation measures in production can be at least partly explained by these time bottlenecks.

On the evidence of such examples as Siemens Medical Solutions in Erlangen and Forchheim, there can be no doubt that manufacturing in Germany that follows flexitime models, is geared to long capital utilization and the current order situation, which integrates production closely into the supply chain and operates with skilled labour trained under the German system of dual vocational training can hold its own in international competition.

5. Summary and Conclusions

As we have seen, China has been very attractive to multinational industrial enterprises that are busy restructuring their value chains in the current major upheaval. A range of factors come together: first, market developments with very high short-term growth rates as well as major long-term growth potential; second, the availability of an “industrial reserve army” of well qualified labour unlikely to be depleted in the foreseeable future; and, third, a government support policy that provides not only financial incentives but also complex establishment support, as the example of industrial parks demonstrates.

Spurred by China's accession to the WTO, more and more global players are setting up operations in China. Cooperation with multinational companies in China's socialist modernisation policy is seen as a primary means of increasing the competitiveness of its domestic industry. As we have shown in this paper, the new factories in China are as good or better in terms of performance and control over their industrial processes. However, this can be said almost without exception only for foreign firms that have set up their operations in China since the early 1990s. Chinese companies which have not entered a joint venture with foreign companies clearly lag still farther behind.

The comparison between the infocom and automotive industries shows similarities and differences in the timing and the direction of their rush into China. While in the infocom sector, China is becoming a (the) worldwide production platform for core components and finished products, the impact on global industrial process chains will be more limited in the case of the auto industry. Market and product characteristics in the automotive industry as well as the capabilities and cost levels of local manufacturers are limiting the development of the Chinese automotive industry towards meeting the needs of the domestic market and, to a certain degree, East Asian markets.

The future is far from clear. There are obvious risks and many doubts about the sustainability of the Chinese rate of development. Nevertheless, the development described in this paper poses tough challenges to manufacturing companies and high-wage countries such as Germany. They will have to aim for even higher degrees of automation to offset higher labour costs, and they will have to further improve their process-chain mastery. This would reduce the costs of quality assurance which have strongly increased in proportion in recent years. Robust control processes have also to be introduced in indirect production and in view of their increasing relevance in terms of costs, this could be turned into a real competitive advantage. Proximities to markets or to R&D activities will not, as the example of infocom shows, secure a domestic manufacturing base.

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